

REMARKS

The Office Action dated May 18, 2006, has been received and carefully noted. The above amendments to the claims, and the following remarks, are submitted as a full and complete response thereto.

Claims 1-12 are currently pending in the application, of which claims 1, 3, 5, 7, and 9 are independent. Claims 1, 3, 5, 7, and 9 have been amended to more particularly point out and distinctly claim the invention. No new matter has been added. Claims 1-12 are respectfully submitted for consideration.

An interview was conducted on August 10, 2006, between the Examiner and Applicant's representative. Applicant thanks the Examiner for the courtesies extended to Applicant's representative during the interview. During the interview, the patentability of the claims was discussed. The arguments presented during the interview are described in the Examiner Interview Summary and are expanded upon in the remarks presented below.

Claim 9 was rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 3,941,534 of Hunkar ("Hunkar"). Applicant respectfully traverses this rejection.

Claim 9, upon which claims 10-12 depend, is directed to a method for controlling an injection molding machine in order to control the movement of a molten resin in a heating cylinder of the injection molding machine, the injection molding machine including a screw arranged within the heating cylinder to be rotatable and to be linearly movable and having a flight of a pitch P, the molten resin being moved in a forward

feeding direction during a plasticization process and an injecting process. The method includes linearly moving the screw backwards relative to the forward feeding direction of the molten resin at a constant backward speed. The method also includes controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards. The method further includes controlling a rotation speed of the screw based on a constant backward speed of the screw, wherein the controlling comprises simultaneously rotating the screw in the forward feeding direction at a the rotation speed corresponding to the constant backward speed, either after completion of the plasticization process and before starting the injecting process or after completion of the injecting process and before starting the plasticization process.

In certain embodiments of the present invention, controlling a rotation speed R of the screw based on a constant backward speed V of the screw either after the completion of the measuring process and before starting the injecting process or after completion of the injecting process and before starting the measuring process is performed. As a result, it is advantageously possible to control positively the density distribution of the molten resin in the heating cylinder, in particular, the molten resin accumulated at the nose portion of the screw.

In the injection molding machine, generally, after completion of the plasticization process, the molten resin pressure at the nose portion of the screw is high because of the back pressure caused in the plasticization process. If the mold is opened in the state that the molten resin pressure at the nose portion of the screw is high, the molten resin can

leak from the runner of the fixed mold because of the high pressure. Furthermore, after completion of the injecting process, the high molten resin pressure caused by the injecting process remains in the nose portion of the screw. In order to precisely control the back pressure in the plasticization process, it is advantageous that the high molten resin pressure caused in the injecting process be reduced, and, subsequently, that the control of the back pressure be carried out under the reduced molten resin pressure, namely, in the reset state. In the plasticization process, however, when the screw is only moved backwards without rotation thereof, since the resin is applied to the flight of the screw, the resin is also likely to be dragged backwards together with the flight. As a result, uniformity of the density distribution of the molten resin can be hampered at the nose portion of the screw (see page 4 in the specification).

Under such circumstances, as addressed by certain embodiments of the present invention, controlling a rotation speed R of the screw can be performed based on a constant backward speed V of the screw either after the completion of the measuring process and before starting the injecting process or after completion of the injecting process and before starting the measuring process. Thereby, it is possible advantageously to control positively the density distribution of the molten resin accumulated at the nose portion of the screw.

Furthermore, in certain embodiments of the present invention, controlling a rotation speed R of the screw can be performed based on a constant backward speed V of the screw either after the completion of the measuring process and before starting the

injecting process or after completion of the injecting process and before starting the measuring process. In such an embodiment, since the feed amount of the molten resin is controlled, it is possible advantageously to control directly the density distribution of the molten resin and it is therefore possible advantageously to control precisely the density of the molten resin.

Applicant respectfully submits that Hunkar does not disclose or suggest all of the elements of any of the presently pending claims, and therefore cannot provide the above-described critical and unobvious advantages.

Hunkar generally relates to an injection molding control system. As explained at column 6, lines 44-58, one objective of Hunkar is to provide means for controlling the screw speed in a programmed manner as a function of the ram position or time during plasticization as the ram is being retracted. Hunkar indicates that such control can “enable controlled variation in density of the molded article throughout its volume.” (Emphasis added.)

Moreover, at column 27, lines 37-63, Hunkar indicates that the speed of the screw can be programmed as a function of ram position during the plasticizing cycle. Hunkar indicates that it is possible to impart varying temperature profiles to the injection charge. In particular, Hunkar states that if the screw speed is increased, the temperature of the front of the charge will be higher, thus less viscous. Moreover, Hunkar indicates that the less viscous front portion of the charge will pack more densely, which Hunkar suggests

may be important because the front part of the charge will form the surface of the molded article.

Furthermore, as explained at column 28, lines 24-35, Hunkar indicates that if the ram is retracted at a constant, uniform velocity, the screw speed can be programmed as a function of time rather than position.

Thus, Hunkar discloses that the density of the molten resin is controlled by obtaining the predetermined temperature profile. However, such a control is carried out during the plasticization process as mentioned in column 6, lines 48-50, thereof, and never is carried out either after the completion of the measuring process and before starting the injecting process or after completion of the injecting process and before starting the measuring process.

Because of the issue of timing, if the technique disclosed in Hunkar is used after completion of the plasticization process, when the molten resin pressure at the nose portion of the screw is high because of the back pressure caused in the plasticization process, the molten resin leaks from the runner of the fixed mold because of the high pressure. Furthermore, if the measuring process is carried out with the high molten resin pressure caused by the injecting process remaining in the nose portion of the screw (to the extent this is discussed by Hunkar), it will be impossible to control precisely the density of the molten resin. Accordingly, one of ordinary skill in the art would not have a reasonable expectation of success in modifying the timing of Hunkar to correspond with the period either after the completion of the measuring process and before starting the

injecting process or after completion of the injecting process and before starting the measuring process.

Moreover, the technique of Hunkar, which controls the density of the molten resin corresponding to the temperature profile is a method for changing the characteristic (physical properties) of the molten resin. Such a method that controls the density by changing the characteristic of the molten resin is inferior in response and makes it hard to maintain a uniform density distribution of the molten resin during one shot (one mold cycle).

Furthermore, since it is hard to detect directly the temperature of the molten resin in the injection molding machine, generally, the temperature of the heating cylinder is detected and the detected temperature of the heating cylinder is substituted for the temperature of the molten resin. However, since the temperature of the heating cylinder is influenced by the change of the outside temperature, it is impossible to control precisely the density of the molten resin using Hunkar's technique. Accordingly, Hunkar's technique would not reasonably enable one of ordinary skill in the art to control precisely the density of molten resin within the heating cylinder.

Claim 9 recites "controlling a density distribution of molten resin at a nose portion of the screw" and "controlling a rotation speed of the screw based on a constant backward speed of the screw, wherein the controlling comprises simultaneously rotating the screw in the forward feeding direction at a rotation speed corresponding to the constant backward speed" and doing so "either after completion of the plasticization

process and before starting the injecting process or after completion of the injecting process and before starting the plasticization process.” Applicant respectfully submits that these features are neither disclosed nor suggested by Hunkar.

The Office Action asserted that the feature “controlling a density distribution of molten resin at a nose portion of the screw” was disclosed by Hunkar at column 6, lines 50-58, and column 27, lines 37-63. Applicant respectfully disagrees with the Office Action’s analysis.

The only reference to controlled density in Hunkar is with respect to the finished product, as can be seen from column 6, line 55 “density of the molded article” and from column 27, lines 53-63, indicating that the material from the front portion of the charge will “pack more densely” and provide “a high resolution” or “a glossy surface.” Accordingly, there is no disclosure or suggestion of what is claimed, namely “controlling a density distribution of molten resin at a nose portion of the screw.” Accordingly, it is respectfully submitted that Hunkar does not disclose or suggest at least this feature of claim 9.

The Office Action asserted that the feature “controlling a rotation speed of the screw based on a constant backward speed of the screw, wherein the controlling comprises simultaneously rotating the screw in the forward feeding direction at a rotation speed corresponding to the constant backward speed” is disclosed by Hunkar at column 28, lines 24-35. Applicant respectfully disagrees with the Office Action’s analysis.

There is no mention in the cited passage of Hunkar of rotating the screw in the forward feeding direction. Even assuming that Hunkar disclosed rotating the screw in the forward feeding direction (not admitted), there is no disclosure that the “rotation speed” is “corresponding to the constant backward speed” or that the correspondence is controlled. Instead, Hunkar discloses that the rotation speed of the screw can **either** be a function of ram position or time. Neither position nor time is velocity. Indeed, velocity is defined as rate of change of position with respect to time. Accordingly, Hunkar does not disclose what is claimed, namely “simultaneously rotating the screw in the forward feeding direction at a rotation speed corresponding to the constant backward speed.” Therefore, Applicant respectfully submits that Hunkar does not disclose or suggest this additional feature of claim 9.

Furthermore, claim 9 recites that the process is carried out “either after completion of the plasticization process and before starting the injecting process or after completion of the injecting process and before starting the plasticization process.” As explained above, Hunkar’s technique is performed during the plasticization cycle, and it would not have been obvious to modify Hunkar’s technique to be performed “either after completion of the plasticization process and before starting the injecting process or after completion of the injecting process and before starting the plasticization process.” Accordingly, for this additional reason, it is respectfully requested that the rejection of claim 9 be withdrawn.

Accordingly, because Hunkar does not disclose or suggest either “controlling a density distribution of molten resin at a nose portion of the screw” or “controlling a rotation speed of the screw based on a constant backward speed of the screw, wherein the controlling comprises simultaneously rotating the screw in the forward feeding direction at a rotation speed corresponding to the constant backward speed” or doing so “either after completion of the plasticization process and before starting the injecting process or after completion of the injecting process and before starting the plasticization process,” Applicant respectfully requests that the rejection of claim 9 be withdrawn.

Claims 1-8 and 10-12 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 4,879,077 of Shimizu et al. (“Shimizu”) in view of Hunkar. Applicant respectfully traverses this rejection.

Claims 10-12 depend upon claim 9, which is discussed above.

Claim 1, upon which claim 2 depends, is directed to a method for controlling an injection molding machine including a heating cylinder and a screw disposed in the heating cylinder, and performing a plasticization/measuring process and an injecting process. The method includes controlling a rotation speed R of the screw based on a constant backward speed V of the screw, wherein the controlling comprises defining a synchronization ratio S of a rotation speed of the screw to be 100% when the position of a flight thereof does not apparently move relative to a the constant backward speed V of the screw. The method also includes moving the screw backwards at the constant backward speed V while rotating it either after completion of the measuring process and

before starting the injecting process or after completion of the injecting process and before starting the measuring process. The method further includes controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards. The rotation speed R of the screw during the backward movement is given by multiplying the rotation speed R , which is expressed by the equation, $R = \text{backward speed } V/\text{pitch } P$ of the flight, by an arbitrary synchronization ratio S_x .

Claim 3, upon which claim 4 depends, is directed to a method for controlling an injection molding machine including a heating cylinder, a screw disposed in the heating cylinder, a first driving source for driving the screw in an axial direction, a second driving source for rotating the screw, position detecting means for detecting an axial position of the screw, rotation-speed detecting means for detecting the rotation speed of the screw, and a controller for controlling the first driving source and the second driving source dependent on the detecting signals transmitted from the position detecting means and the rotation-speed detecting means, and performing a plasticization/measuring process and an injecting process. The method includes controlling a rotation speed R of the screw based on a constant backward speed V of the screw, wherein the controlling comprises defining a synchronization ratio S of a rotation speed of the screw to be 100% when the position of a flight thereof does not apparently move relative to a the constant backward speed V of the screw. The method also includes controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards. The controller moves the screw backwards at the constant backward speed V .

while rotating it either after the completion of the measuring process and before starting the injecting process or after completion of the injecting process and before starting the measuring process. The rotation speed R of the screw during the backward movement is given by multiplying the rotation speed R , which is expressed by the equation, $R =$ backward speed V /pitch P of the flight, by an arbitrary synchronization ratio $S_x..$

Claim 5, upon which claim 6 depends, is directed to a method for controlling an injection molding machine in order to perform a resin plasticization/measuring process and an injecting process, wherein the injection molding machine includes a heating cylinder and a screw having a flight of a pitch P , the screw being arranged within the heating cylinder. The method includes controlling a rotation speed R of the screw based on a constant linear backward speed V of the screw, wherein the controlling comprises defining a synchronization ratio S with reference to the rotation speed R and the constant linear backward speed V of the screw, the synchronization ratio S being equal to 100% when the flight does not apparently move while the screw is rotated and linearly moved backwards, the synchronization ratio S being smaller than 100% when the flight moves backwards while the screw is rotated and linearly moved backwards, the synchronization ratio S being greater than 100% when the flight moves forwards while the screw is rotated and linearly moved backwards. The method also includes controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards. The method further includes controlling the screw to linearly move backward at a selected synchronization ratio S_x and simultaneously rotate either after

completion of the plasticization/measuring process and before starting the injecting process or after completion of the injecting process and before starting the plasticization/measuring process. A selected rotation speed R_s of the screw is given by $R_s = (V/P) \times S_x$.

Claim 7, upon which claim 8 depends, is directed to a method for controlling an injection molding machine in order to perform a resin plasticization/measuring process and an injecting process, wherein the injection molding machine includes a heating cylinder, a screw having a flight of a pitch P and arranged within the heating cylinder, a first driving source for driving the screw in an axial direction, a second driving source for rotating the screw, a position detecting device for detecting an axial position of the screw, a rotation-speed detecting device for detecting the rotation speed of the screw, and a controller for controlling the first and the second driving sources in response to detecting signals transmitted from the position detecting device and the rotation-speed detecting device. The method also includes controlling a rotation speed R of the screw based on a constant linear backward speed V of the screw, wherein the controlling comprises defining a synchronization ratio S with reference to the rotation speed R of the screw and the constant linear backward speed V of the screw, the synchronization ratio S being equal to 100% when the flight does not apparently move while the screw is rotated and linearly moved backwards, the synchronization ratio S being smaller than 100% when the flight moves backwards while the screw is rotated and linearly moved backwards, the synchronization ratio S being greater than 100% when the flight moves forwards while

the screw is rotated and linearly moved backwards. The method further includes controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards. The method additionally includes controlling the movement so that the screw is linearly moved backward at a selected synchronization ratio S_x and simultaneously controlling the rotation of the screw, either after completion of the plasticization/measuring process and before starting the injecting process or after completion of the injecting process and before starting the plasticization/measuring process. A selected rotation speed R_s of the screw is given by $R_s = (V/P) \times S_x$.

As explained above, certain embodiments of the present invention provide numerous critical and unobvious advantages. Applicant respectfully submits that the combination of Shimizu and Hunkar does not disclose or suggest all of the elements of any of the presently pending claims, and therefore cannot provide the above-described critical and unobvious advantages.

Hunkar is discussed above. As noted above, Hunkar does not disclose or suggest either “controlling a density distribution of molten resin at a nose portion of the screw” or “controlling a rotation speed of the screw based on a constant backward speed of the screw, wherein the controlling comprises simultaneously rotating the screw in the forward feeding direction at a rotation speed corresponding to the constant backward speed” or doing so “either after completion of the plasticization process and before starting the injecting process or after completion of the injecting process and before starting the plasticization process,” as recited by claim 9.

Claims 1, 3, 5, and 7 also recite “controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards” and doing so “either after completion of the plasticization process and before starting the injecting process or after completion of the injecting process and before starting the plasticization process.” Thus, for the reasons explained above, Applicant respectfully submits that Hunkar also does not disclose those feature of claims 1, 3, 5, and 7.

Moreover, claim 5 recites “controlling the screw to linearly move backward at a selected synchronization ratio Sx.” Hunkar also does not disclose this feature of claim 5. There is no discussion in Hunkar of selecting a synchronization ratio, or even recognition in Hunkar that a synchronization ratio could be selected, much less any disclosure or suggestion of controlling the screws linear backward movement according to a selected synchronization ratio. Accordingly, it is respectfully submitted that Hunkar does not disclose or suggest at least this additional feature of claim 5.

Claim 7 likewise recites “controlling the movement so that the screw is linearly moved backward at a selected synchronization ratio Sx.” For similar reasons to those explained above with regard to claim 5, it is respectfully submitted that Hunkar fails to disclose or suggest at least this additional feature of claim 7.

Shimizu does not remedy any of the above-described deficiencies of Hunkar. Shimizu generally relates to a control method of an injection molding machine. Shimizu, at column 2, lines 58-62 states that a “screw 2 is rotated in the reverse direction to the rotational direction in the measuring process at the same time when screw 2 is moved

forward in the injection process. The apparent position of ridge 2h or groove 2d of screw 2 is set to become stationary in a predetermined position in the heating cylinder.” Shimizu also describes, at column 2, lines 48-51 setting a reverse rotational speed, or r , of screw 2 using the equation $r \geq Vs/L$, where Vs is the injection (forward moving) speed of screw 2 and L is the pitch of screw 2.

It can be seen, therefore, that Shimizu never discloses the idea that the screw is moved backwards at the constant backward speed while rotating it either after the completion of the measuring process and before starting the injecting process or after completion of the injecting process and before starting the measuring process.

If the technique disclosed in Shimizu is used after completion of the plasticization process, when the molten resin pressure at the nose portion of the screw is high because of the back pressure caused in the plasticization process, the molten resin will leak from the runner of the fixed mold because of the high pressure. Further, if the measuring process is carried out when the high molten resin pressure caused by the injecting process remains in the nose portion of the screw, it will be impossible to control precisely the density of the molten resin. Accordingly, one of ordinary skill in the art would not have a reasonable expectation of success in modifying the technique of Shimizu to be performed at the time claimed.

Even if the technique of Shimizu is combined with the technique of Hunkar that the density of the molten resin is controlled by obtaining the predetermined temperature profile, still there would be no teaching in the combination that the screw is linearly

moved backwards relative to the forward feeding direction of the molten resin while rotating it either after the completion of the measuring process and before starting the injecting process or after completion of the injecting process and before starting the measuring process.

The Office Action acknowledged that Shimizu does not disclose or suggest “controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards.” Accordingly, it is respectfully submitted that the combination of Shimizu and Hunkar cannot disclose or suggest this feature, because Shimizu does not remedy the deficiencies of Hunkar with regard to this feature. Accordingly, for at least this reason it is respectfully submitted that claims 1, 3, 5, 7, and 9 recite subject matter that is neither disclosed nor suggested in the combination of Shimizu and Hunkar.

Claims 2, 4, 6, 8, and 10-12 depend from claims 1, 3, 5, 7, and 9 respectively and recite additional limitations. Accordingly, it is respectfully submitted that each of claims 2, 4, 6, 8, and 10-12 recites subject matter that is neither disclosed nor suggested in the combination of Shimizu and Hunkar.

With regard to the feature “controlling the screw to linearly move backward at a selected synchronization ratio S_x ” of claim 5, the Office Action did not address this limitation in the rejection of claim 5. Likewise, the feature “controlling the movement so that the screw is linearly moved backward at a selected synchronization ratio S_x ” of claim 7 was not addressed by the Office Action. Shimizu does not disclose these

features. Accordingly, Applicant respectfully submits that there is no basis for maintaining the rejections of claims 5 and 7 or of claims 6 and 8, which respectively depend from them. Furthermore, Applicant respectfully submits that 37 CFR 1.104(c)(2) requires that, when the reference is complex or shows or describes inventions other than that claimed by the applicant, the particular part relied on must be designated as nearly as practicable. If the rejection is maintained, it is respectfully requested that the particular part relied upon be designated more precisely.

For the reasons explained above, it is respectfully submitted that each of claims 1-12 recites subject matter that is neither disclosed nor suggested in the cited art. It is, therefore, respectfully requested that all of claims 1-12 be allowed, and that this application be passed to issue.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, Applicant's undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, Applicant respectfully petitions for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,


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Enclosures: Petition for a Two-Month Extension of Time
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